CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S1301

Project Title
Pascal's Triangle and Infinite Dimensions

Abstract

Objectives/Goals
The initial idea was to determine if Pascal's Triangle could be created in 3- dimensions, & if so, to discover the underlying formula, any specific patterns for the 3-D version, & any patterns between the versions.

Methods/Materials
Starting with a basic understanding of Pascal's Triangle, which is a series of numbers that represent the coefficients of the expression [X + Y]^N. A pyramid shaped three-dimensional version of Pascal's Triangle was built and tested. It was constructed using the idea that each variable created an "axis", or line of ones on an edge, along with a simple rule: Each axis has to have a non-intersecting plane or area connecting it to every combination of all other axis. If something of this magnitude could be made, then Dr. Kitto would help find the underlying formula for the pyramid. Possible patterns between the versions of Pascal's triangle were studied, & work began on a 4-d version, using time as a fourth dimension.

Results
The result of the experimentation was pyramid shaped string of numbers, which, interestingly, has Pascal's original triangle on each face. Dr. Kitto was able to locate a formula, [X+Y+Z]!/X!Y!Z!, which provided the underlying formula for the pyramid. No provable patterns were found between the levels constructed, but there were a few that appeared to exist & looked promising.

Conclusions/Discussion
Dr. Kitto was able to locate a formula, [X+Y+Z]!/X!Y!Z!, which also had an interesting pattern between itself & the other versions of the triangle. This pattern is that the other versions are always present just "not looked at," or equal to zero. In other words, they are all still there. So, the formula is REALLY [a(1)+a(2)+....+a(n-1)+a(n)]!/a(1)!*a(2)!*....*a(n-1)!*a(n)!, where any a(n) not used is equal to zero. For the original triangle, for example, the equation is [a(1)+a(2)+0(1)+0(2)+....+0(n)]!/a(1)1*a(2)!*0(1)!*...*0(n)!. It is important to note that 0!=1, so the equation would be totally & completely unchanged if one were to "add or remove" variables at will. Also, it appears that each variable one "adds in" will use a separate dimension than any of the other variables in order to have a unique line, plane, area, space, & set of simplexes with every (all) other variable(s).

Summary Statement
This project is about creating & expanding multi-dimensional versions of Pascal's Triangle.

Help Received
Dr. Kitto helped find formula, many applications for project found on internet